

System-wide Coastal Modeling

Value of MORPHOS Technology for Emergency Preparedness, Flood-fighting and Flood Protection Project Operations

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Presentation Overview

- Status Report on MORPHOS R&D and Ongoing Technology Applications
- Experiences with Applications during Gustav - Storm Preparedness, Flood-fighting, Project Operations
- An Integrated Approach to System-wide Coastal Modeling Enabling :
 - Project Design and Operations
 - Regional Flood Risk Assessment
 - Decision-making Before, During and After Coastal Storm Events

MORPHOS R&D Project

Mission: Develop, verify and apply a physics based coastal and estuarine simulation and prediction capability with emphasis on storm-driven events for estimating risk.

Fully Integrated Process Models



Hurricane Ike: Photos from National Geographic web site



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MORPHOS Status Report

- FY08 funding focused on waves and nearshore dynamics/morphology
- Waves
 - Theoretical advances in shallow water wave-wave interactions; ALPHA version of TSWAVE being exercised to develop new set of source terms
- Nearshore Dynamics
 - Completed CSHORE v1.0, a new profile response model and validated against large data set. Will be ready for application in 2Q of FY09
 - Completed alpha version of C2SHORE, a 2DH shore response model
- Model Evaluation and Benchmarking Test Bed
 - Wave model evaluation system operational for NC region
 - Morphology model evaluation system being set up for CHL FRF



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MORPHOS Status Report

- Circulation and Storm Surge
 - Regional hurricane surge and wave modeling system being applied presently for FEMA (Texas, North Carolina, Chesapeake Bay) - Agency/academia/private sector partnerships
 - Morganza to the Gulf Hurricane Protection Project for New Orleans District
- Climate and Risk
 - Completed version 2 of JPM-OS code (still need to document, standardize, and generalize the code; improve treatment of non-inundation values)
 - Will complete an extended parameter set for Gulf of Mexico hurricanes suitable for driving the MORPHOS-PBL model in 1Q of fy09
- Atmosphere
 - Complete in 1Q of fy09 the MORPHOS-PBL, which will relax assumptions in the present TC96 that the hurricane is removed from land influences and employs a boundary layer with constant height at landfall.

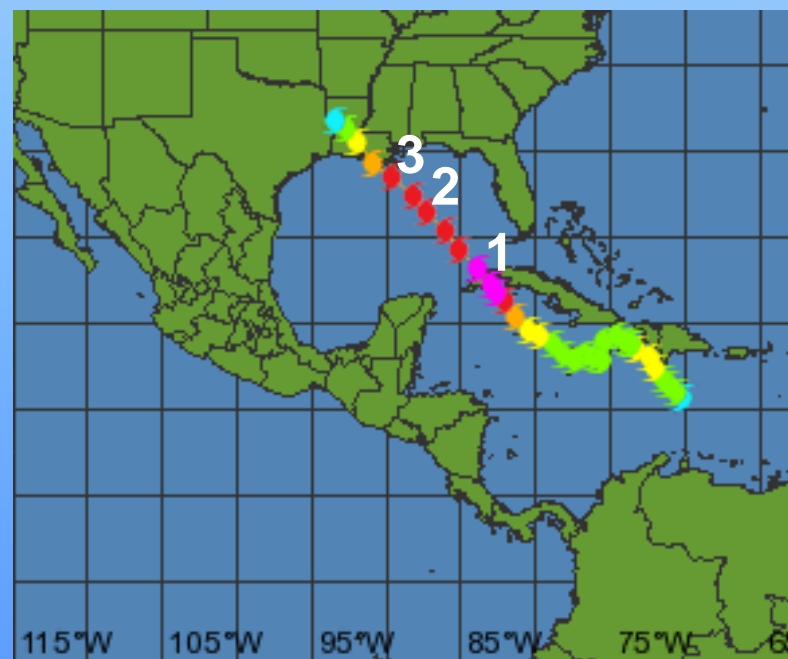


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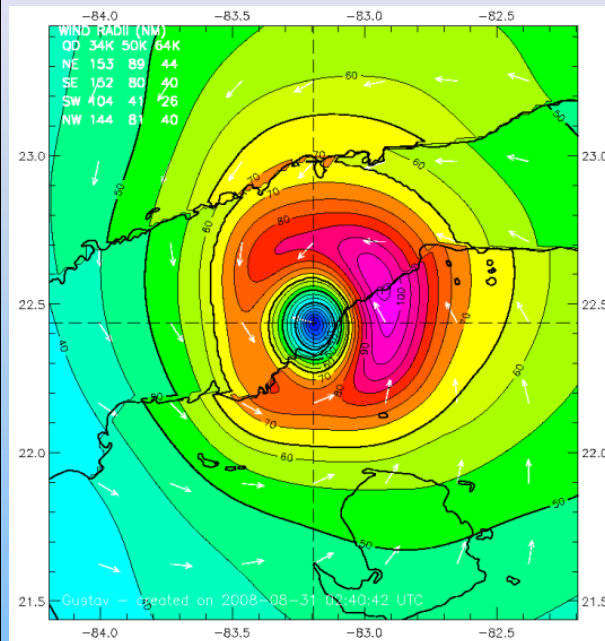


Application of Model Results During Gustav

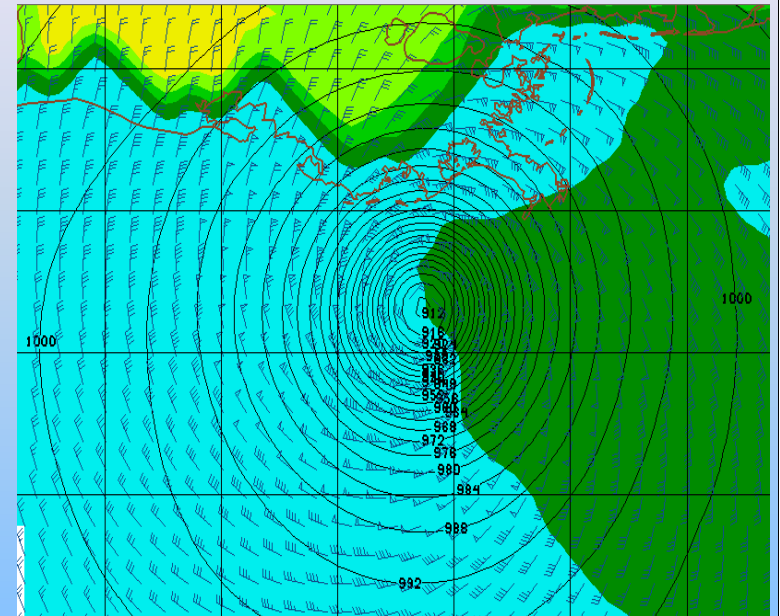
- **Phase 1** - Mining LaCPR Storm Archive produced with MORPHOS technology (incl Regional SL15 ADCIRC Storm Surge Application)
+ NOAA information on forecast storm characteristics (NCEP, AOML HRD, NHC)
- **Phase 2** - Add application of SL15 Light ADCIRC (operational storm surge prediction application)
- **Phase 3** - Add real-time measurements (excellent coverage by New Orleans District and USGS in SE LA, also NOAA)



Estimating Storm Characteristics in the Surge Generation Zone

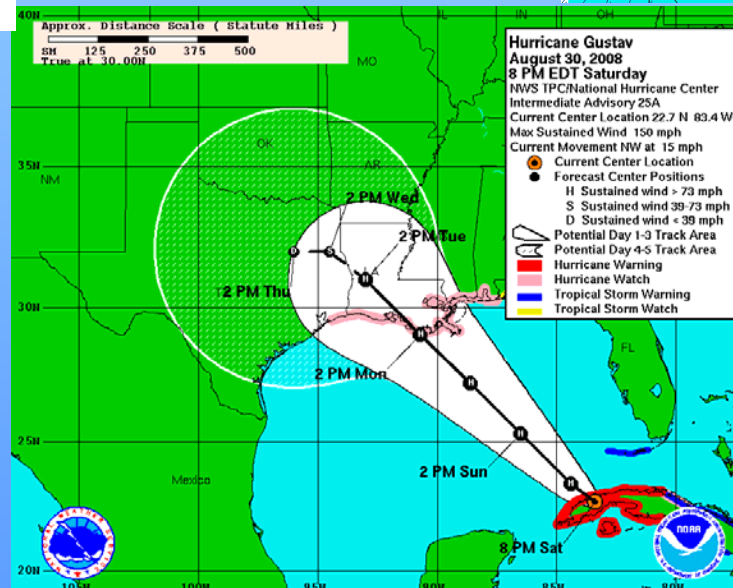


NOAA AOML HRD
 H*Wind Snap Shots -
 Measurement-based
 (C_p , W_{max} , R_{max})



NOAA NCEP HWRF
 and GFDL dynamic
 hurricane forecast
 models
 (C_p , W_{max} , R_{max})

NOAA NHC Forecast
 Advisories and
 Discussions
 (Track and W_{max})

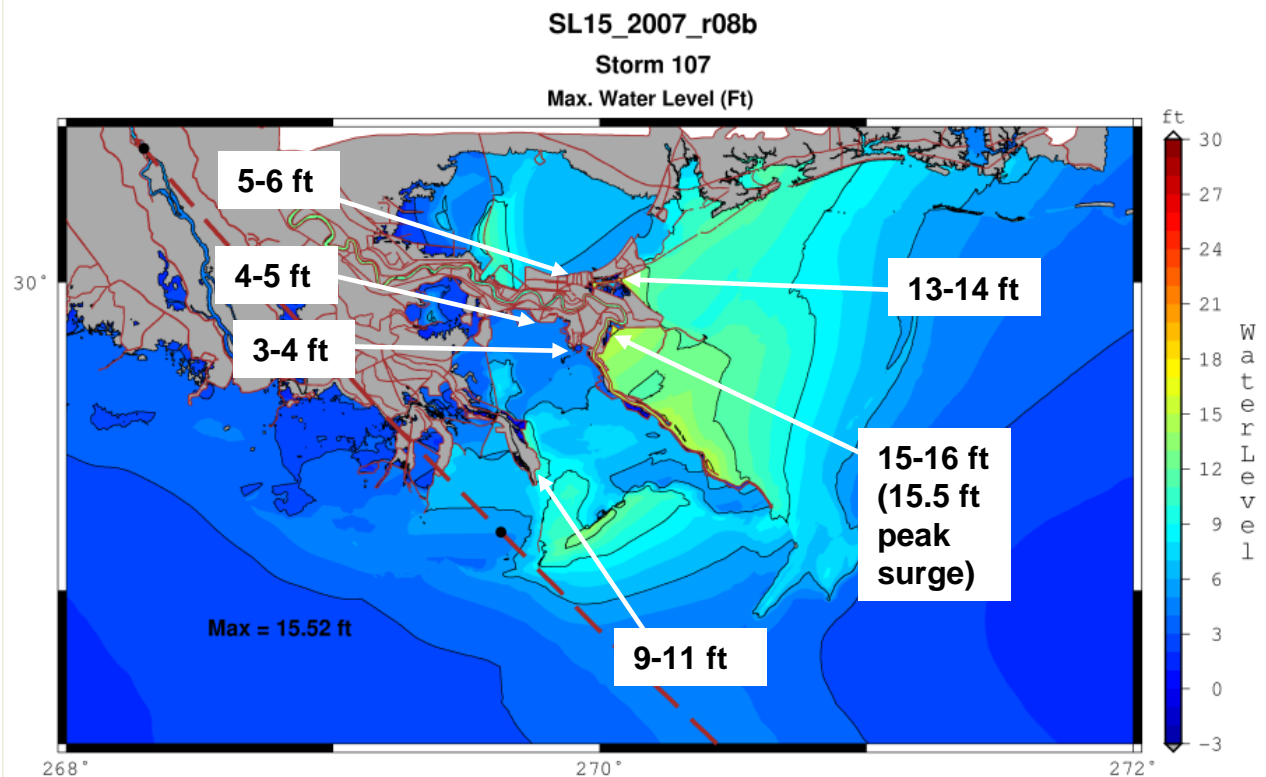
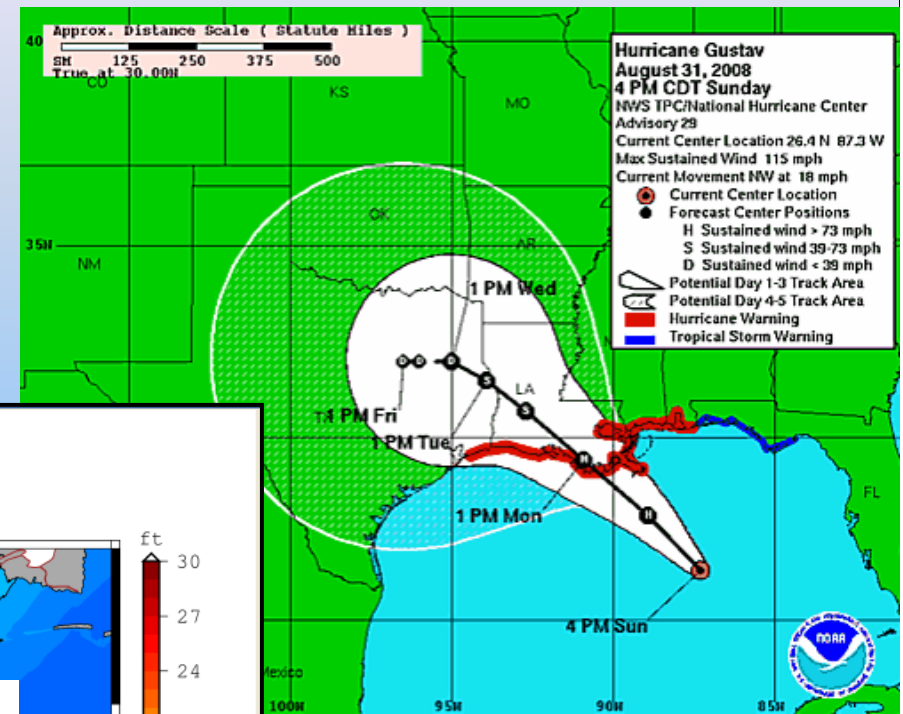


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LaCPR Archive Storm 107 (100-kt) Sun 31 Aug pm

- Advisory 29
- Official storm tracked was shifted eastward
- Forecast intensity is decreasing
- Cp (930 mb)
- Wmax approx 100 kt (NHC forecast 110 kt)
- Rmax (18/25 nm)

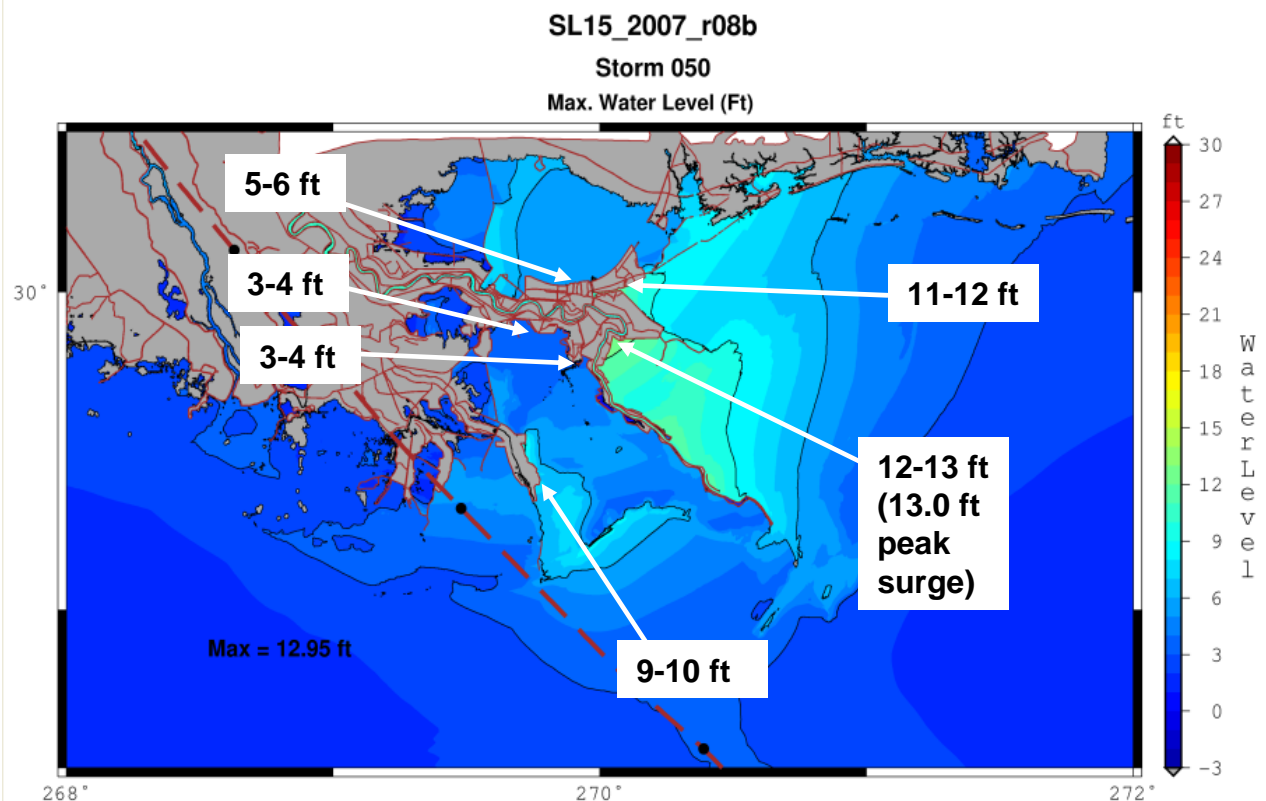
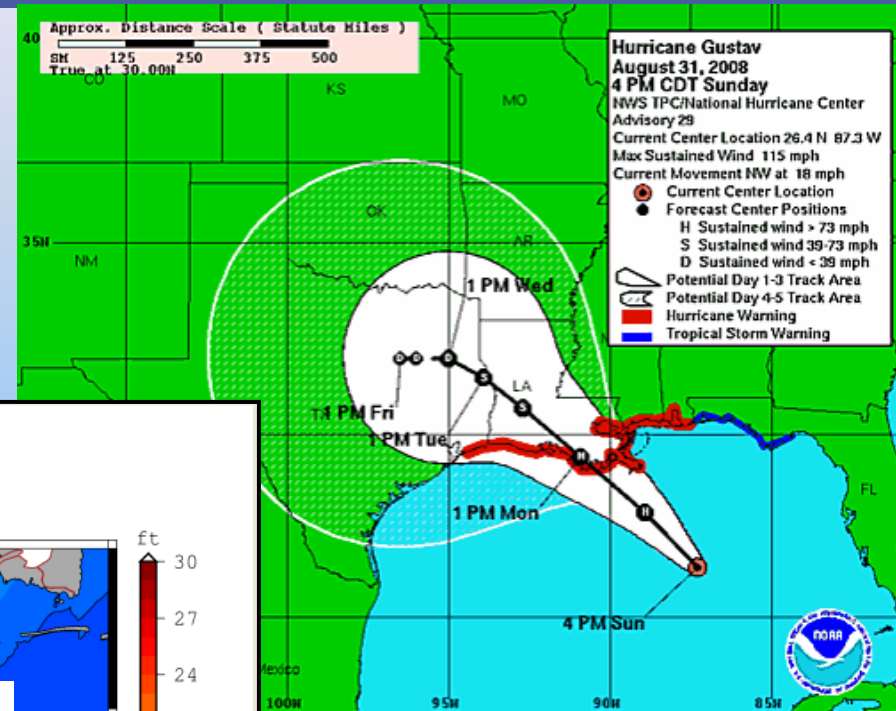


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LaCPR Archive Storm 50 (85-kt) Sun 31 Aug pm

- Same Advisory 29
- Less intense storm than Storm 107; examined to reflect a further decrease in intensity
- Cp (960 mb)
- Wmax 85 kt (NHC forecast 110 kt)
- Rmax (18/25 nm)

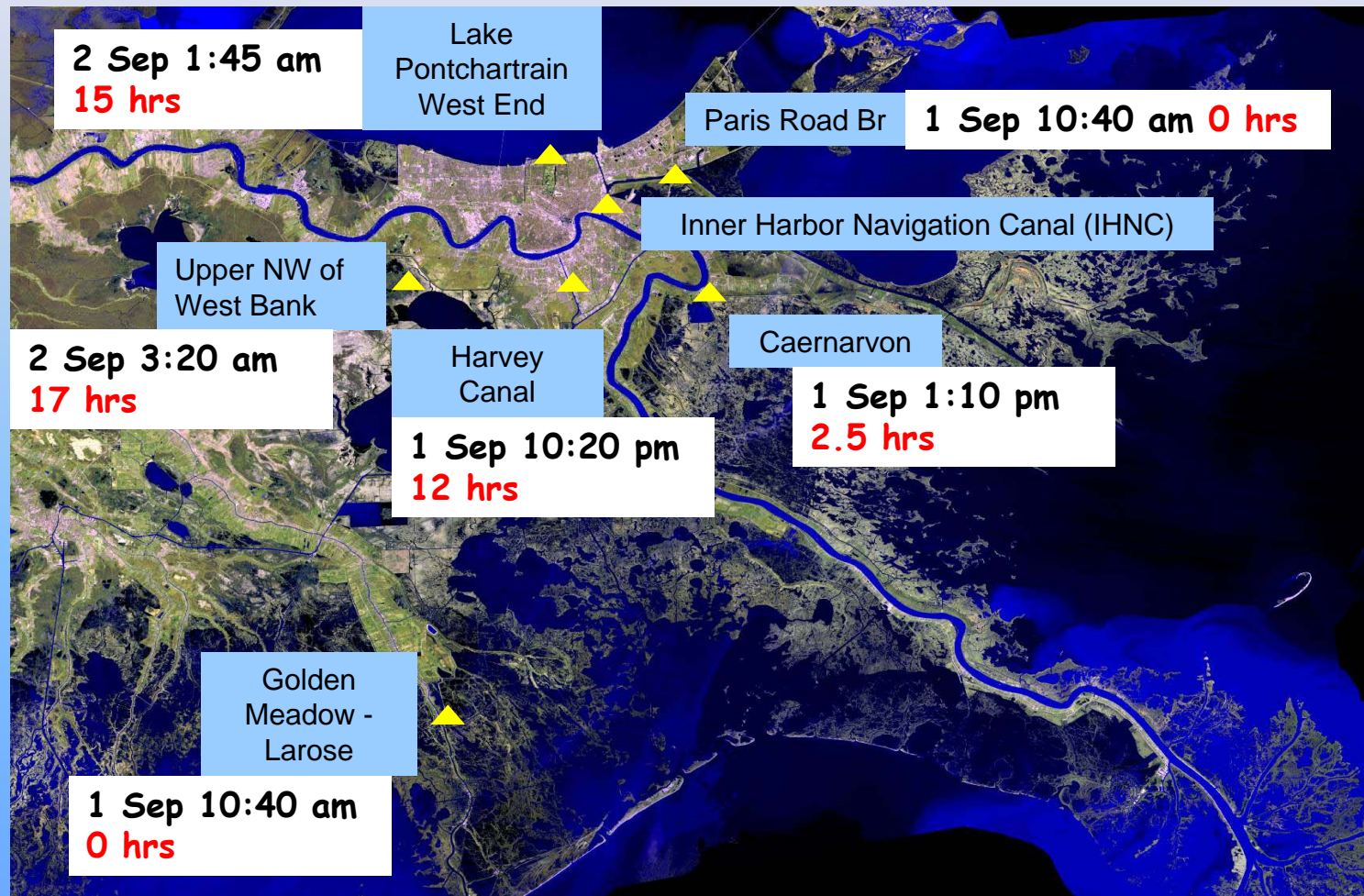


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ADCIRC SL15 Light Predictions

Arrival Time for Peak Surge - Advisory 29



Lag times from peak surge at
Paris Road Bridge shown in red



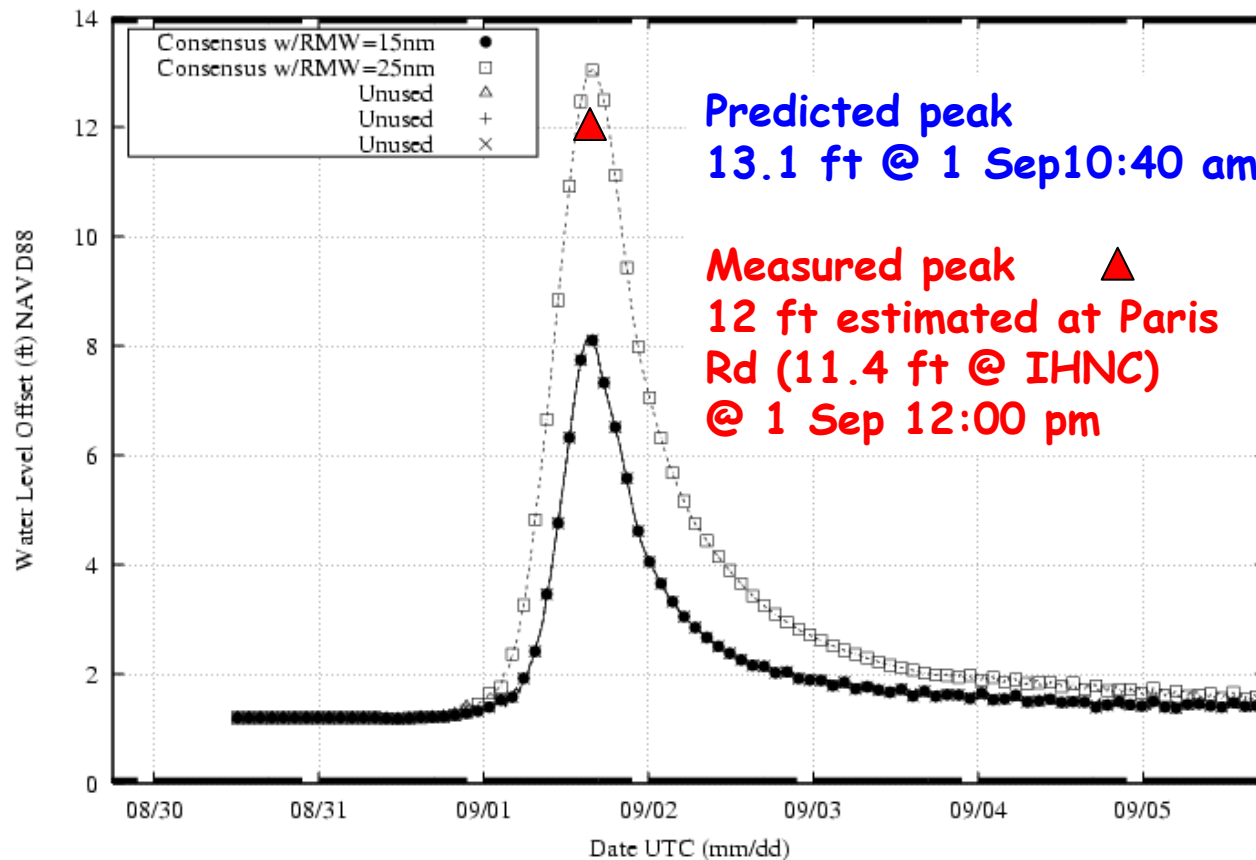
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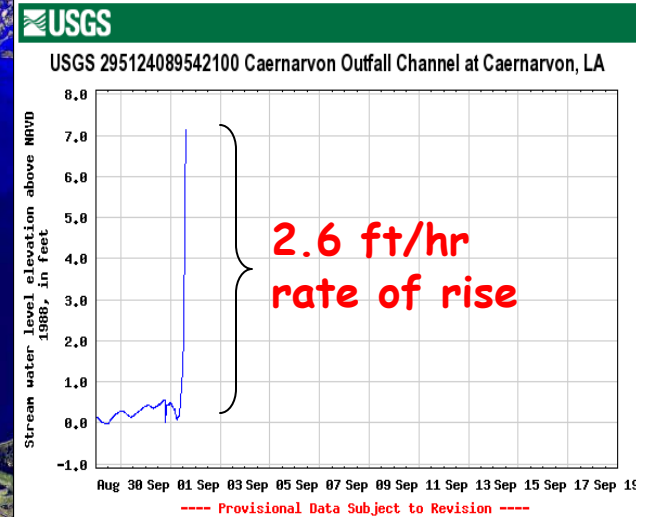
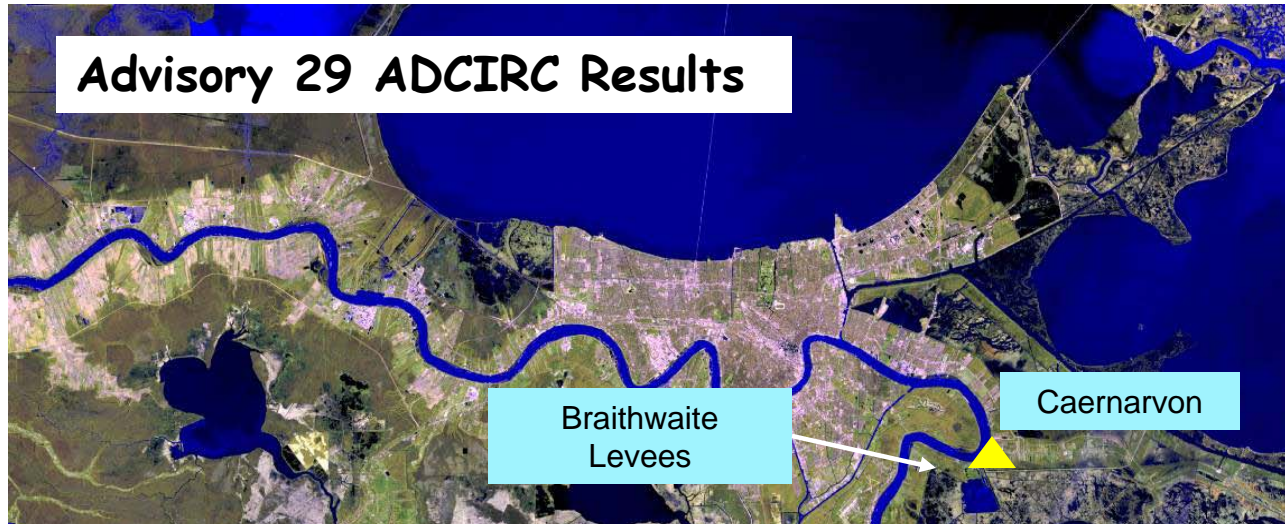
Advisory 29 ADCIRC Results



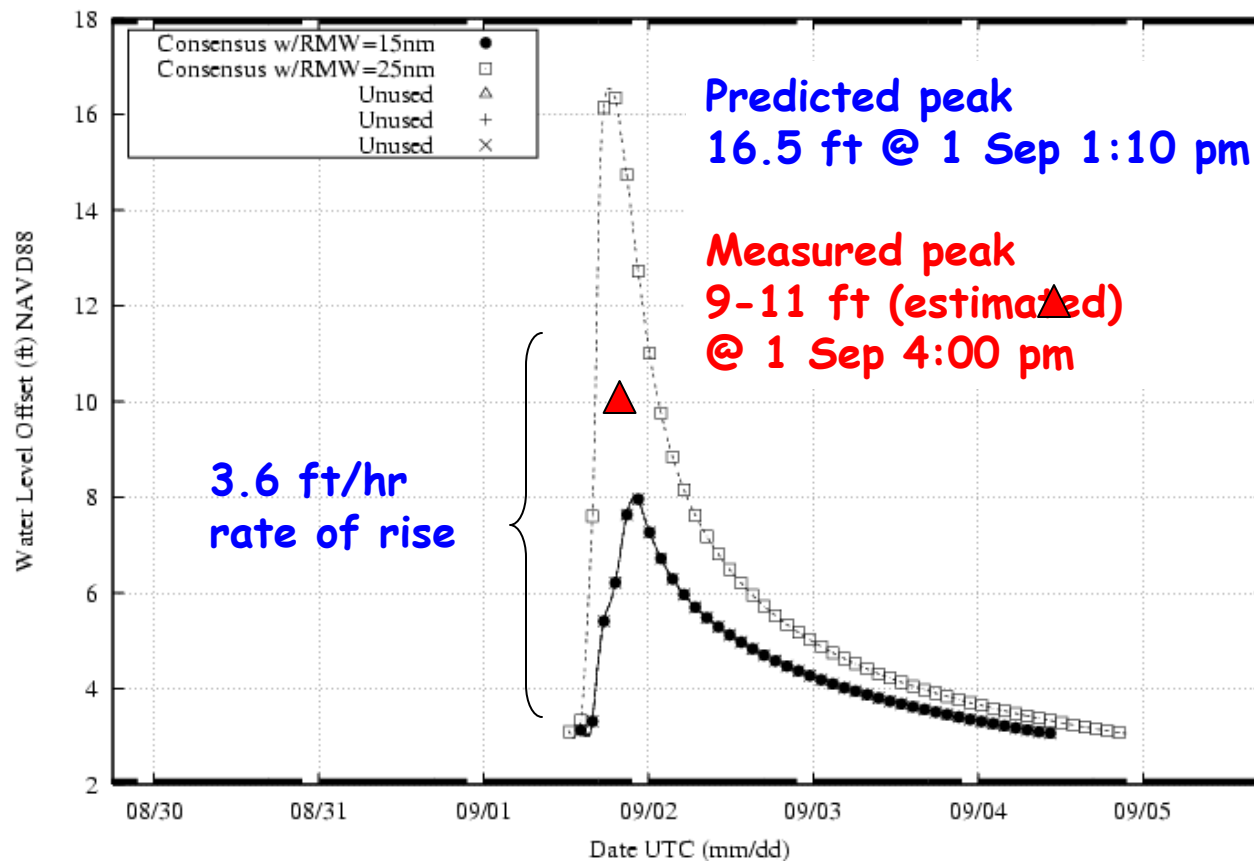
Water Level Offset at Golden Triangle, advisory 2008083118 UTC



Advisory 29 ADCIRC Results



Water Level Offset at Caernarvon, advisory 2008083118 UTC



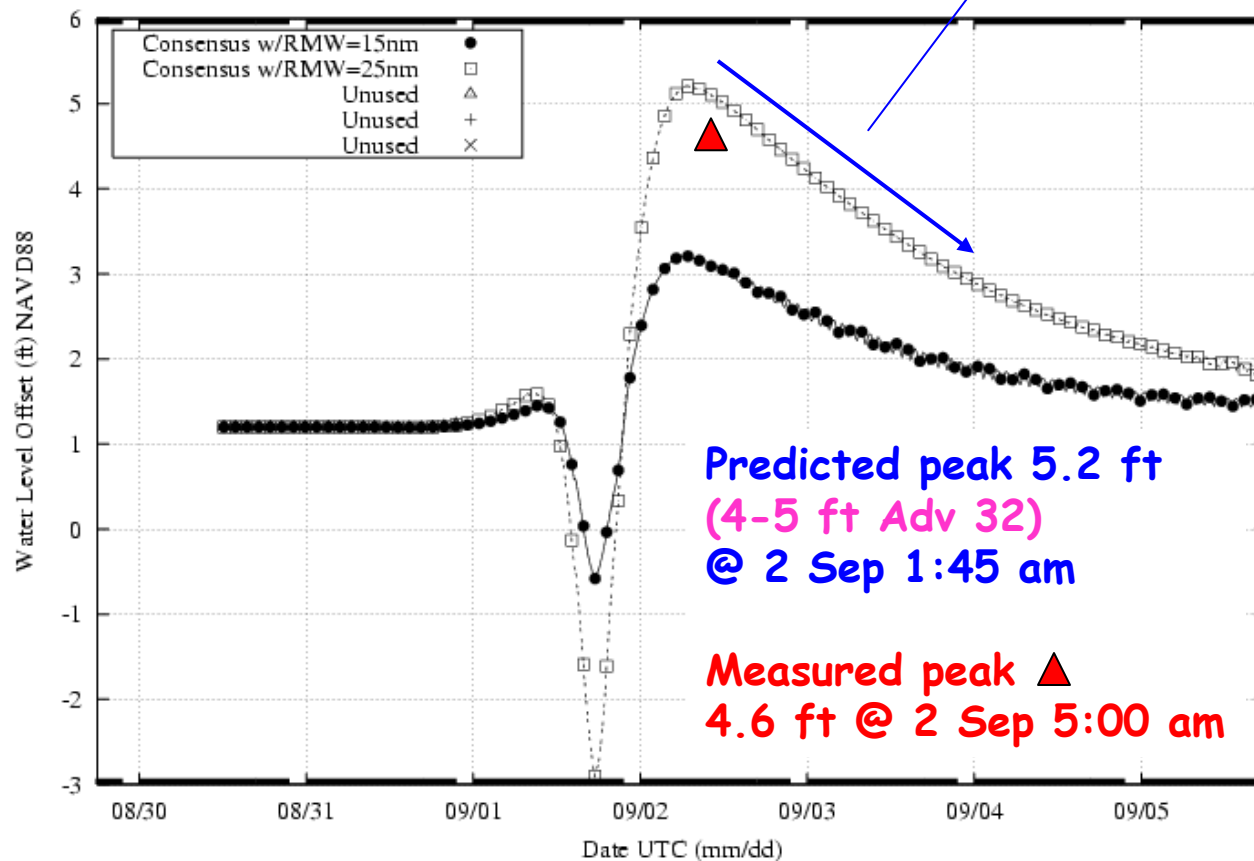
Advisory 29/32 ADCIRC Results

Lake Pontchartrain
West End

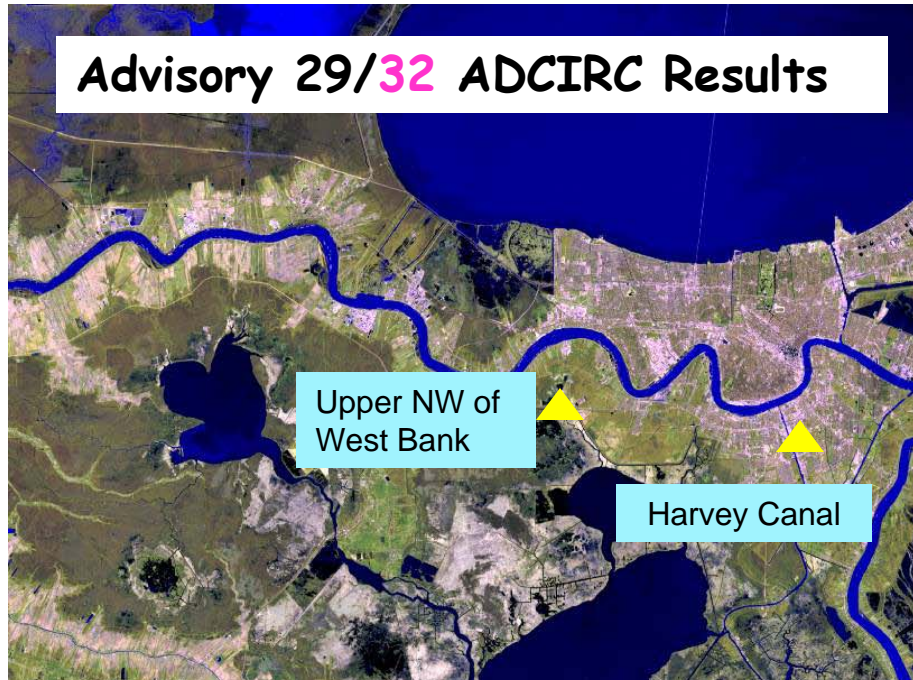
Predicted rate of fall
following the crest
0.054 ft/hr for 2 days

Measured rate of fall
following the crest
0.055 ft/hr for 2 days

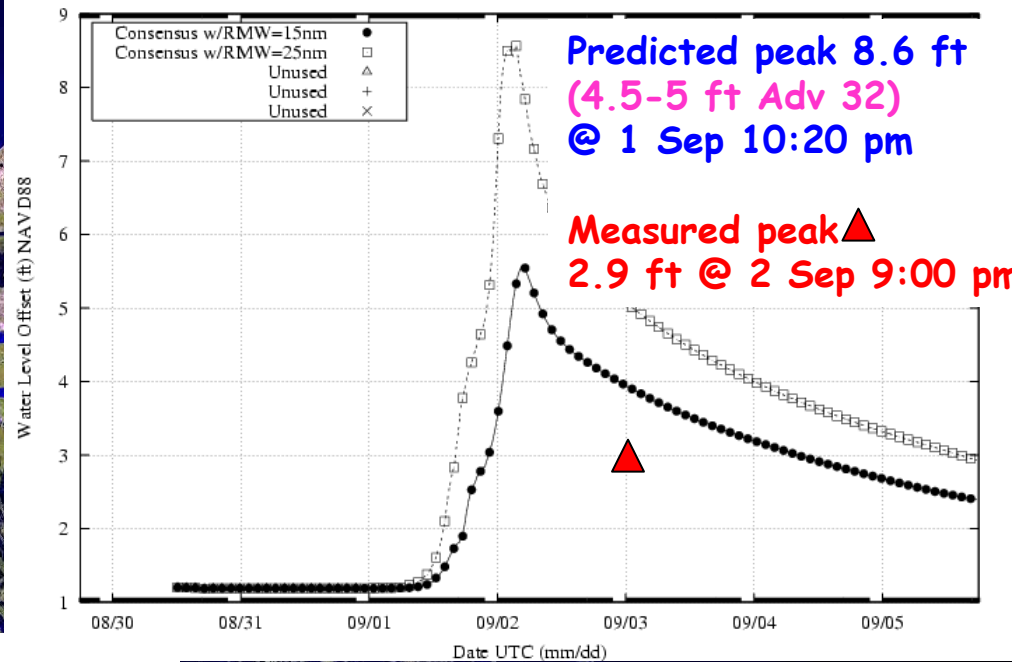
Water Level Offset at London Ave. Canal Outlet, advisory 2008083118 UTC



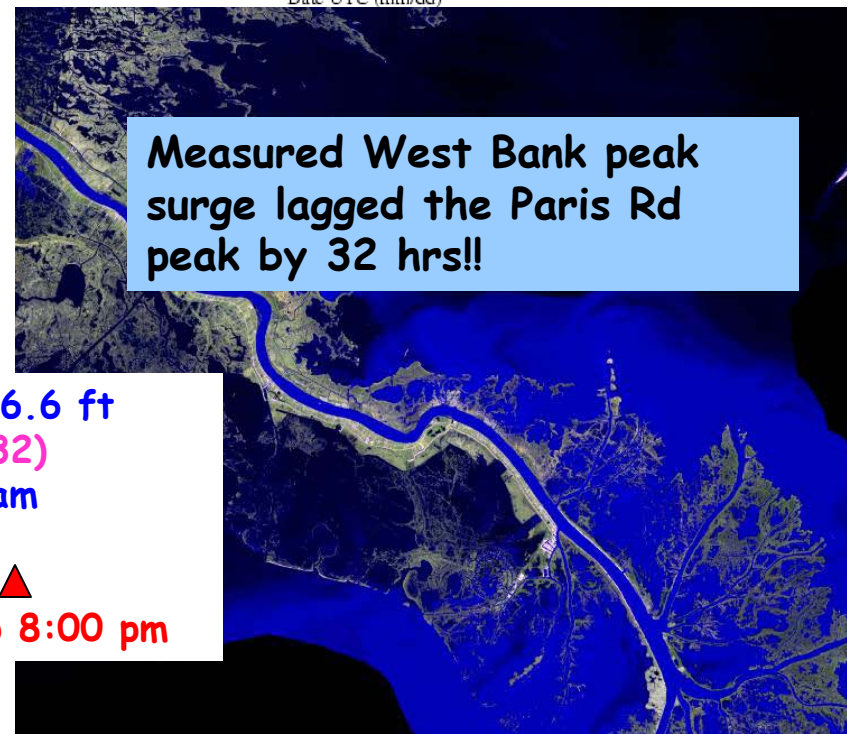
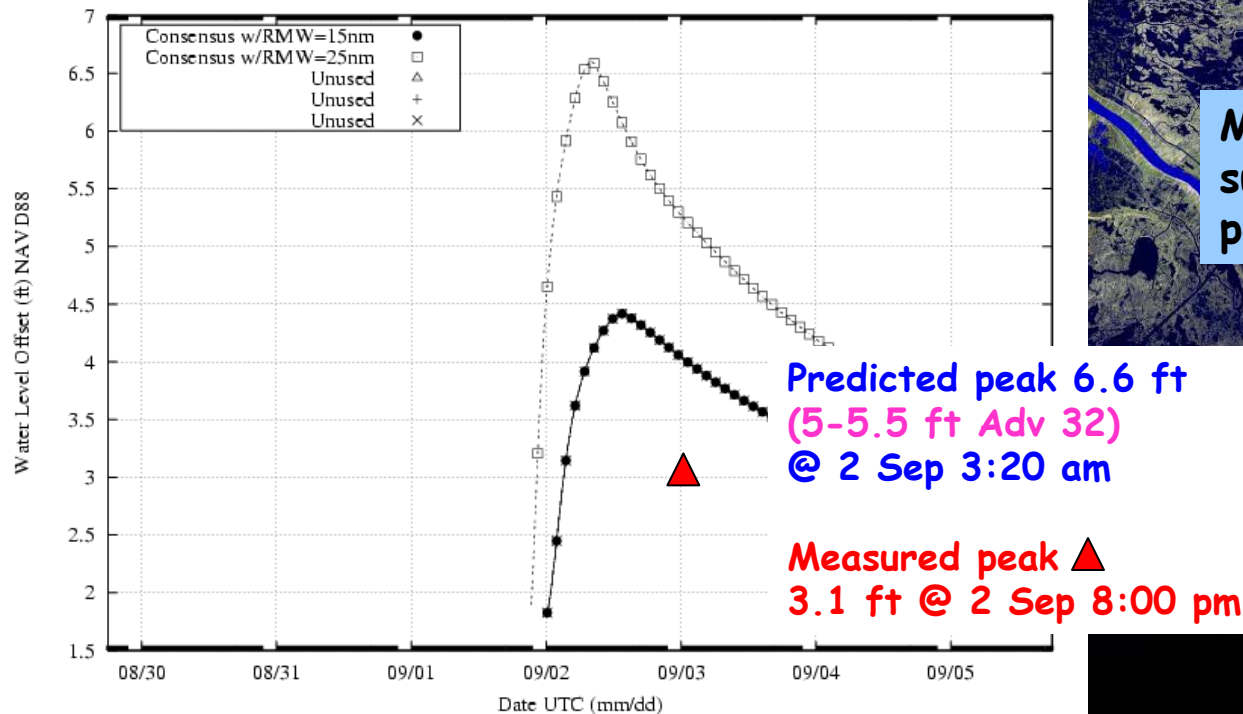
Advisory 29/32 ADCIRC Results



Water Level Offset at Harvey Canal at Lapalco Blvd, advisory 2008083118 UTC



Water Level Offset at Northwest West Bank, advisory 2008083118 UTC



Comparison of Peak Storm Surge

	Location	Measured Peak Water Level NAVD 88	ADCIRC Adv29 Rmax=25	SLOSH Adv 29	SLOSH Adv 30	ADCIRC Adv32 Rmax =25	SLOSH Adv 32	LaCPR Storm 50
<div>East Bank</div> <div>↑</div> <div>↓</div> <div>West Bank</div>	Paris Rd Bridge	12 ft (est) (11.4 ft at IHNC)	13.1	5-5.5	7-7.5	10-10.5	6.5-7	11.3 (IHNC)
	Caernarvon	10 -11 ft	16.5	4.5-5.5	7.5-8.5	10-11	6-6.5	12.2
	Lake Pont. West End	4.6 ft	5.2	2 - 2.5	2-2.5	4-5	2-2.5	5.1
	Golden Meadow-Larose	6.6 ft	12.7	7.5-8	9.5-10.5	10.5-11.5	7.5-8	6.2
	Harvey Canal	2.9 ft	8.6	2.5-3.5	4 -5	4.5-5	2.5-3.5	4.0
	Upper NW of West Bank	3.1 ft	6.6	2-2.5	4.5-5	5-5.5	2.5-3	3.8



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Comparison of Lag Times of Peak Storm Surge

East
Bank



West
Bank



Location	Observed Lag	ADCIRC Adv 29 Rmax = 25	LaCPR Storm 50
Paris Rd Br	---	---	---
Caernarvon	4 hrs	1	4
Lake Pont. West End	17 hrs	15	19
Golden Meadow- Larose	0 hrs	0	2.5
Harvey Canal	33 hrs	12	>24
Upper NW of West Bank	32 hrs	17	>24



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Strengths of Mining the Storm Archive

- Data base from high resolution/comprehensive modeling has great potential for operational use - more accurate than operational models for Gustav
- Greater accuracy result of higher-resolution and better physics (hurricane behavior approaching the coast and wind modeling, wave-surge model coupling)
- Provides wave information for overtopping assessments
- Covers entire region with equally high quality
- Data base can be refined/expanded during non-hurricane season
- Analysis can begin much faster following each advisory



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Improvements to Operational ADCIRC SL15 Light Model

- Improve quality of the wind fields maximizing use of measured data (Cp, Wmax, Rmax, wind decay in radial direction, wind field asymmetry)
- Strength is in simulating actual track, forward speed, actual storm evolution, and opportunity to utilize measured wind fields

Report	NHC	NOAA Hwind analysis			NOAA HWRF/GFDL forecast near landfall			NHC forecast near landfall
Time	Advisory	Cp (mb)	Wmax (kt)	Rmax (nm)	Cp (mb)	Wmax (kt)	Rmax (nm)	Wmax (kt)
Phase 2								
Sun 31 Aug am	28	960	100	13	928	105	33	115
Sun 31 Aug pm	29	953	95	13 - 23	943	95	30	110
Phase 3								
Mon 1 Sep am	32	955	85	25				95



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Integrated Approach - Path Ahead

- Partner with FEMA to capture hypothetical storm data generated in their regional remapping studies (for flood risk assessment, coastal project design and asset management)
- Develop storm data archival system (deep and shallow)
- Examine adequacy of real-time data collection network; improve as required
- Through R&D, develop storm data mining and analysis software, and information delivery process, to support coastal storm preparedness, emergency and project ops (linked to storm archive and real-time data, and mines NOAA data for defining storm characteristics and archive storm selection) - lessons learned and requirements from Gustav experiences
- Improve SE LA ADCIRC SL15 Light application; evaluate setting up "light versions" for other major metropolitan areas as detailed ADCIRC applications are done by FEMA
- Develop working prototype for LA and MS coasts; expand into other regions as data bases are created
- Create information exchange with ENGLink
- Implement the concept for other coasts and coastal storm types

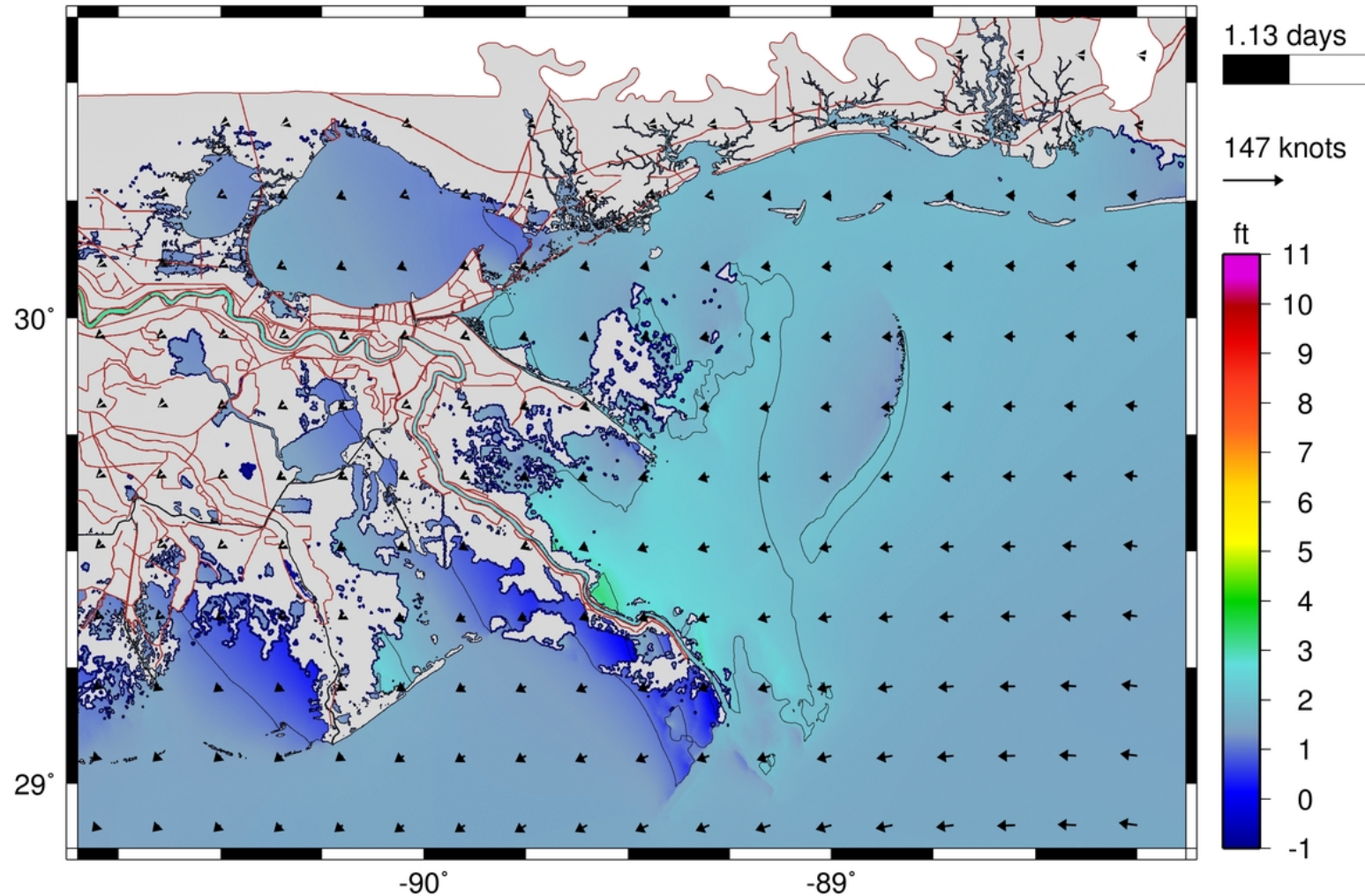
Questions?



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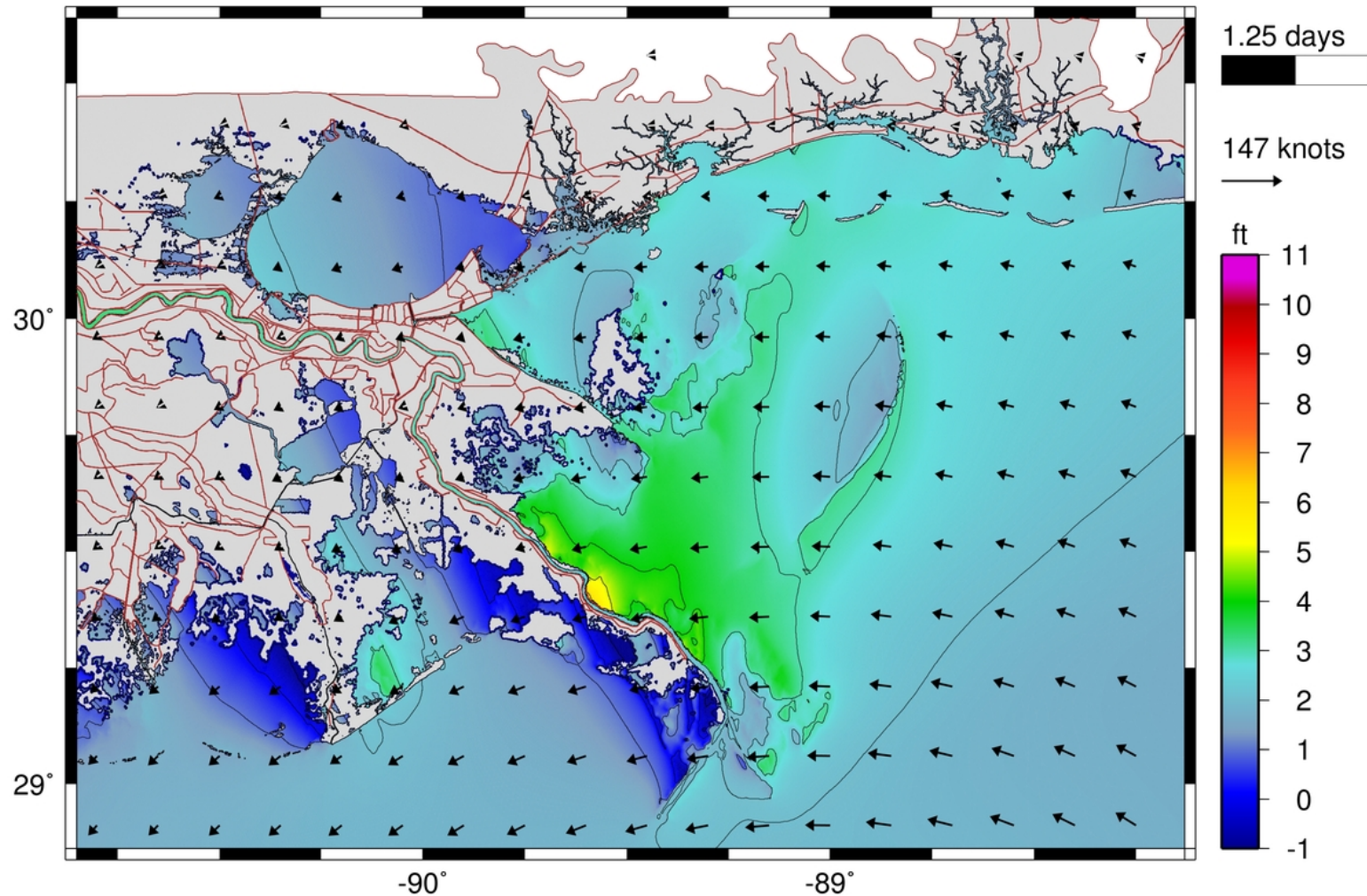


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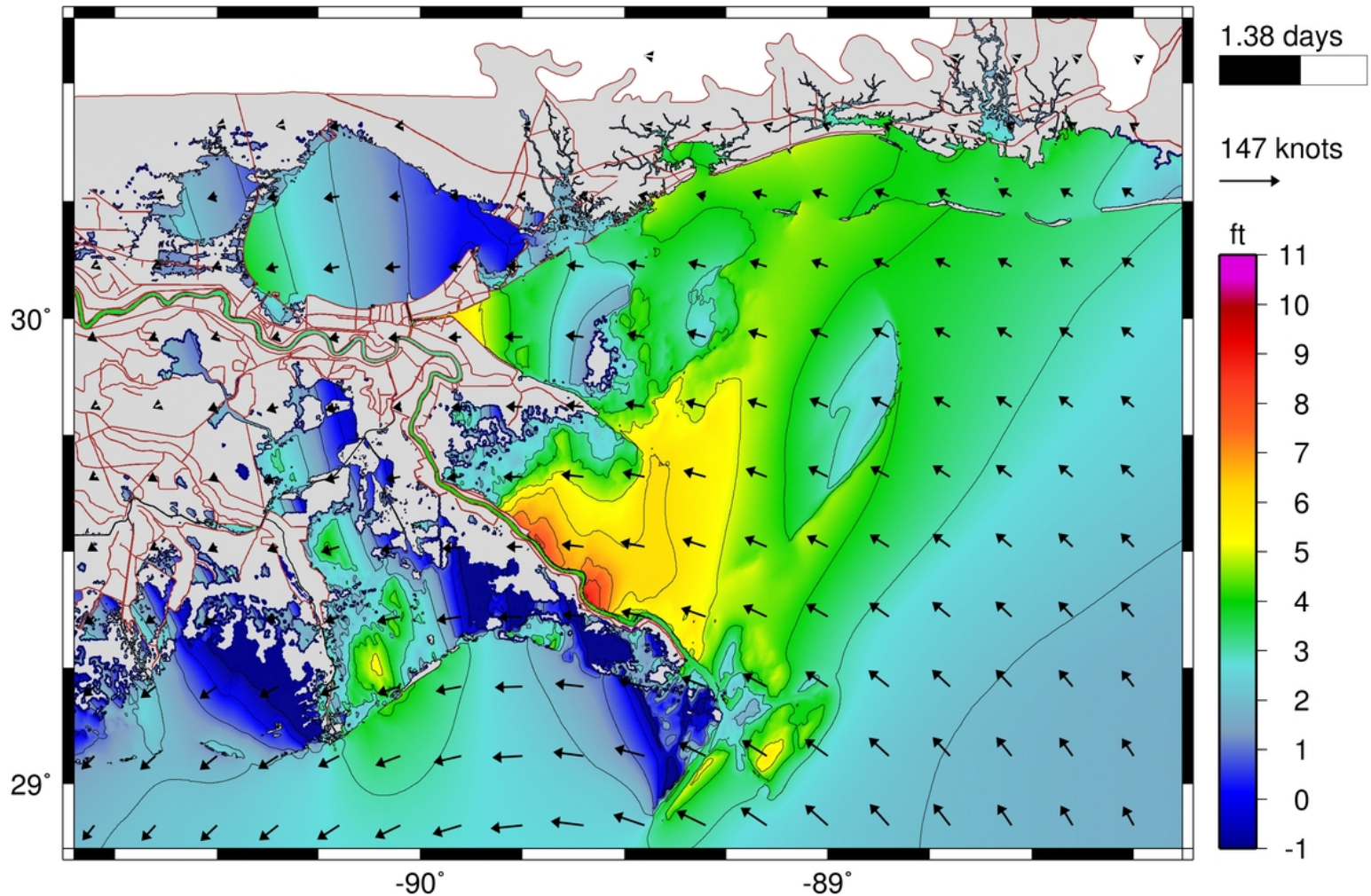
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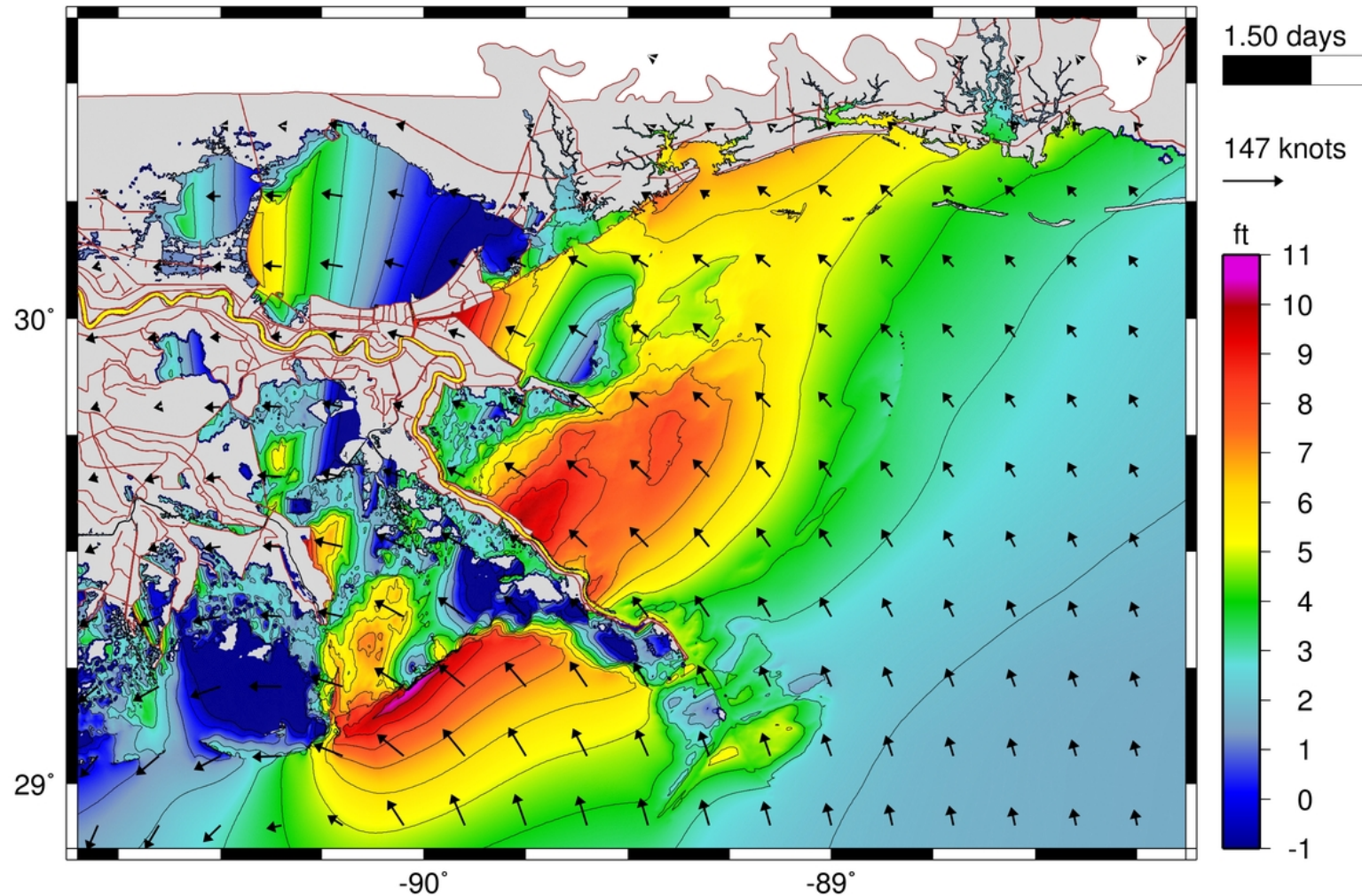
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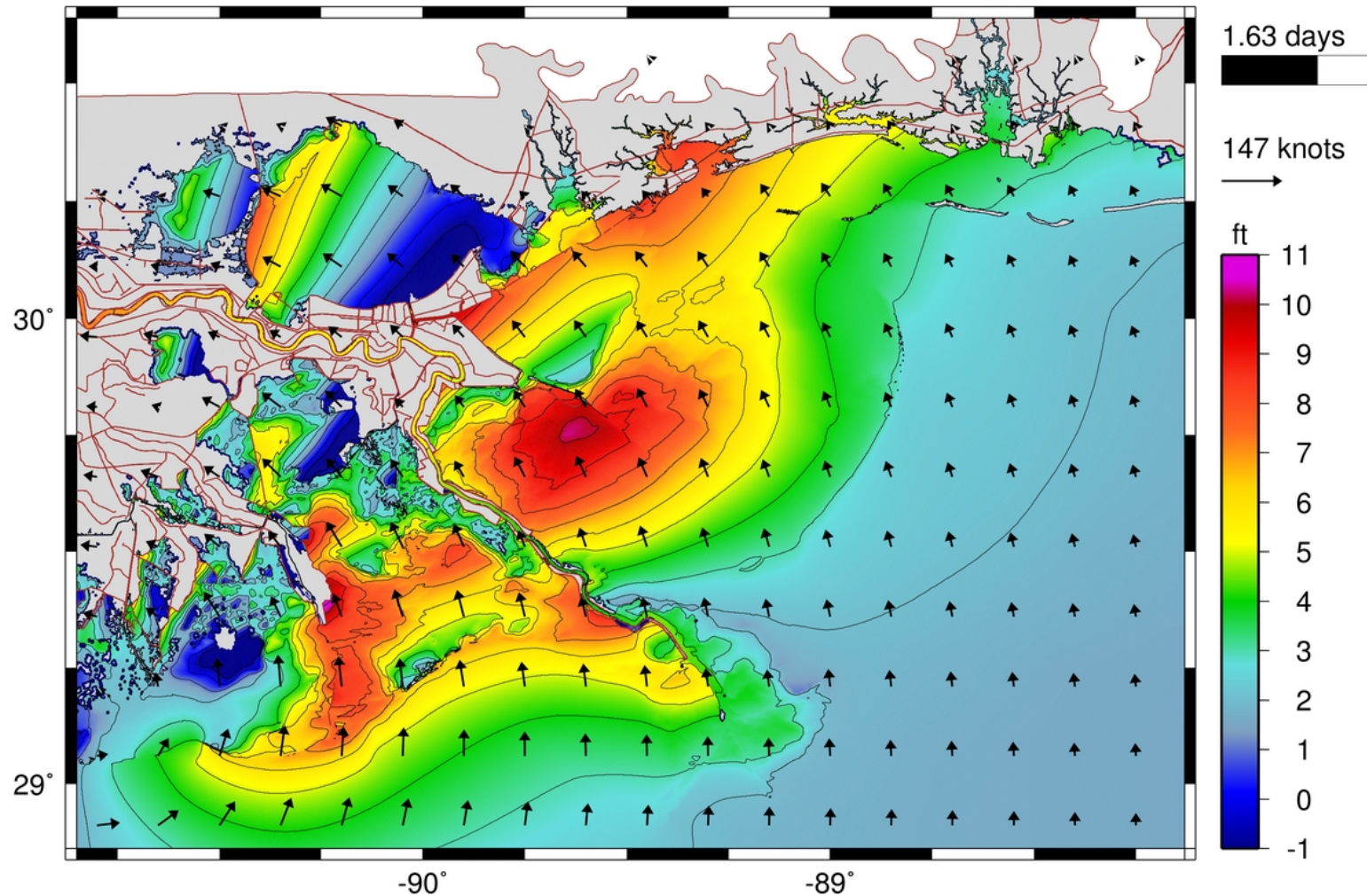


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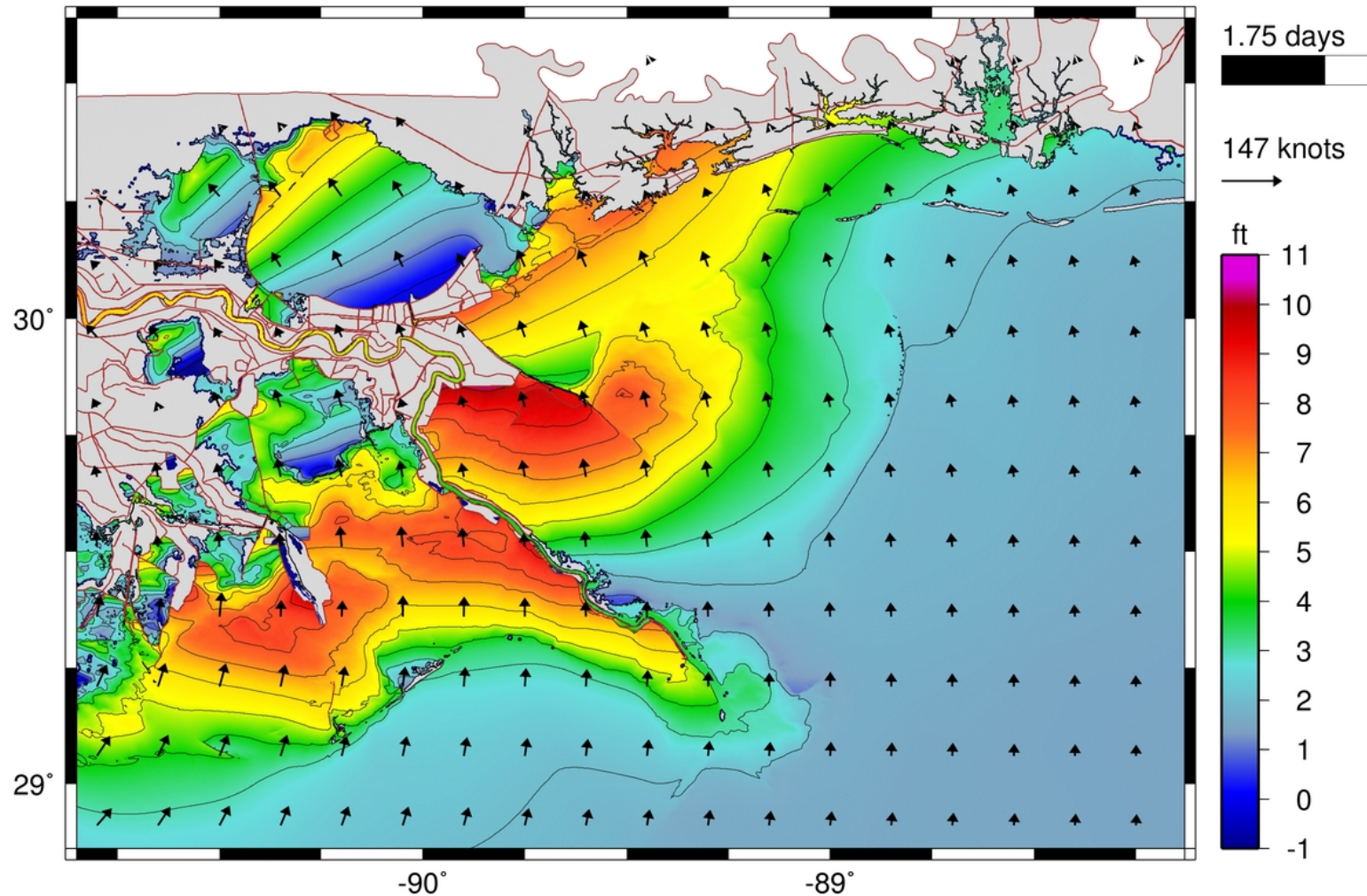
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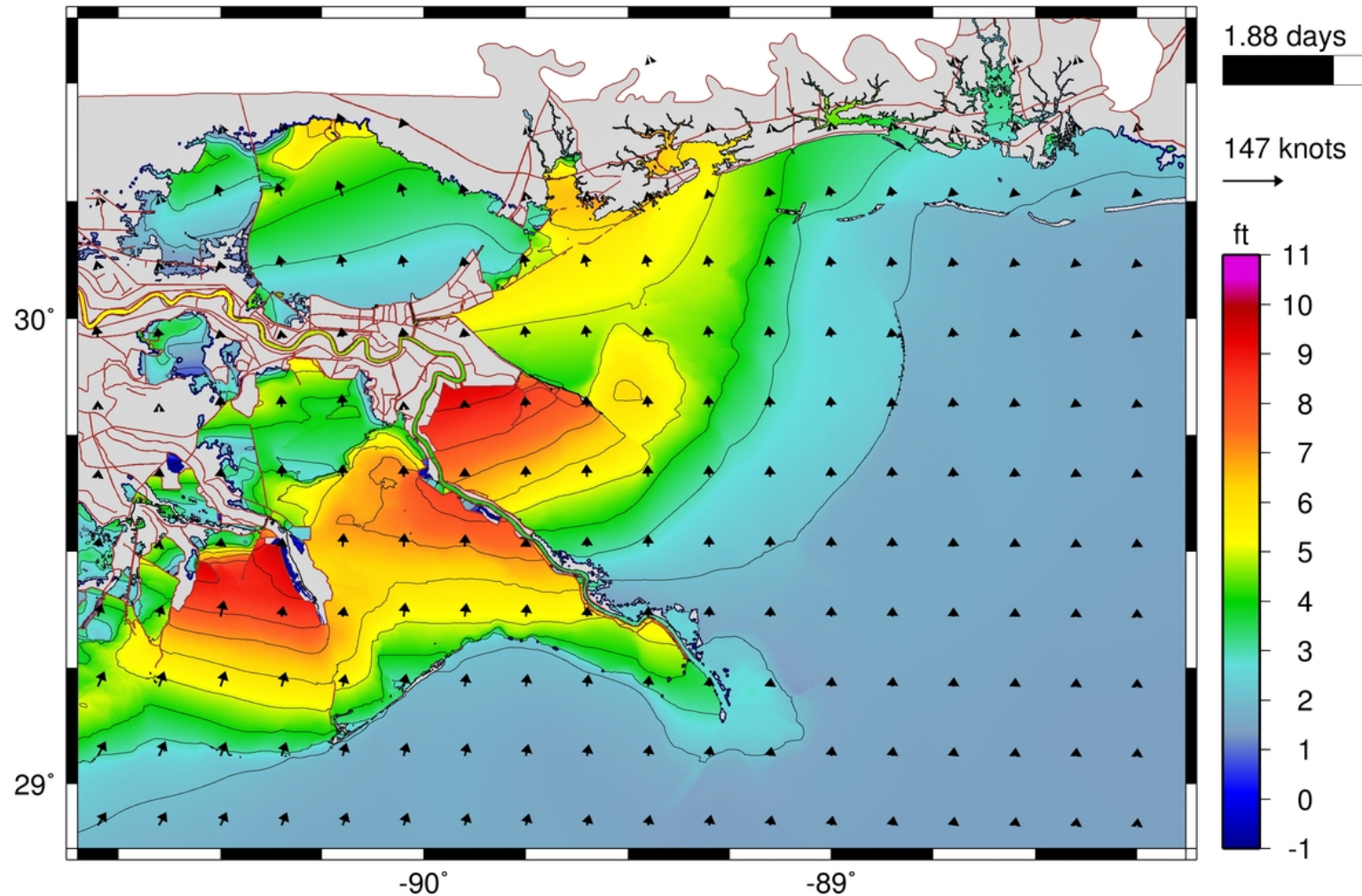
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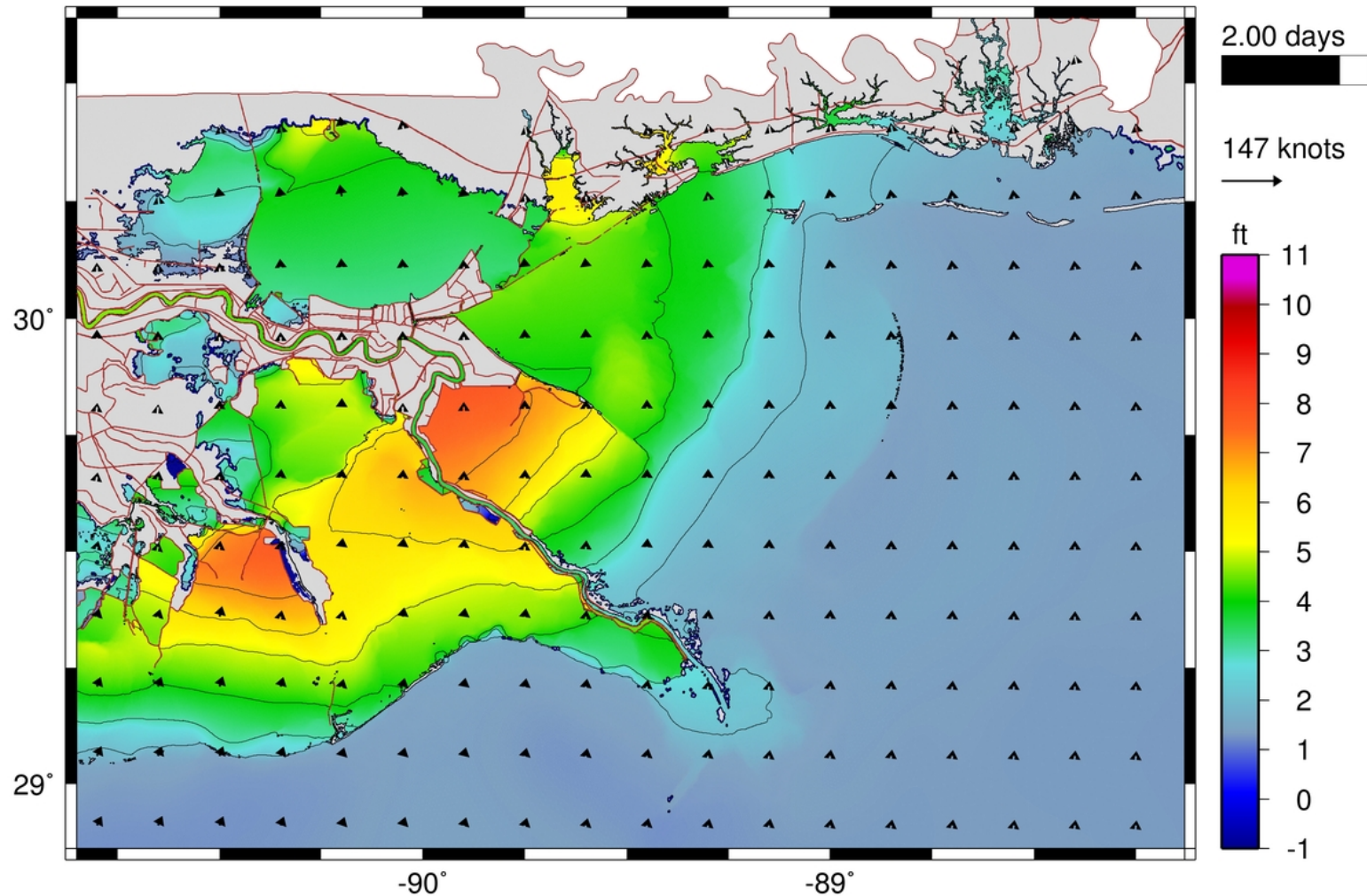
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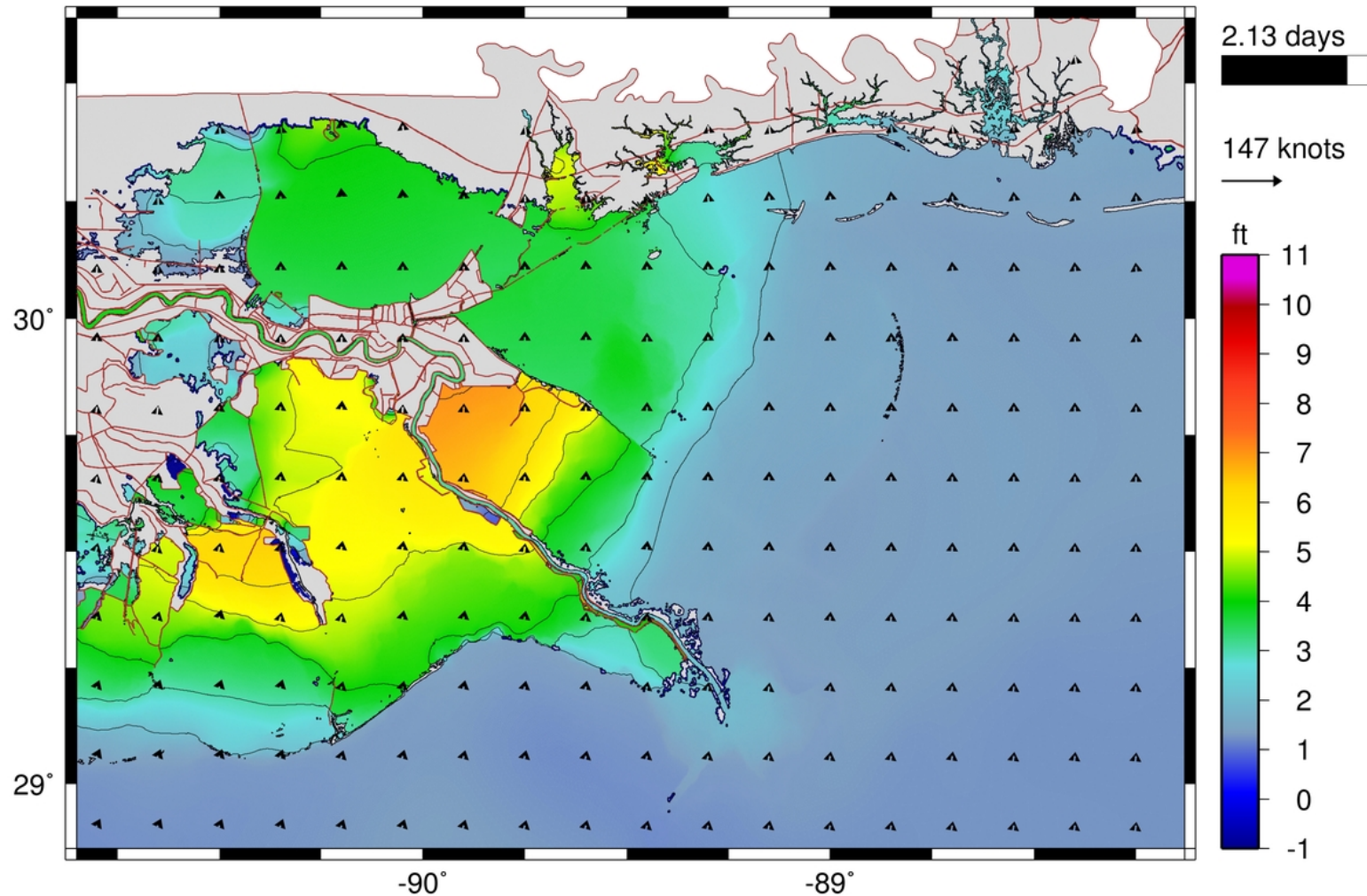
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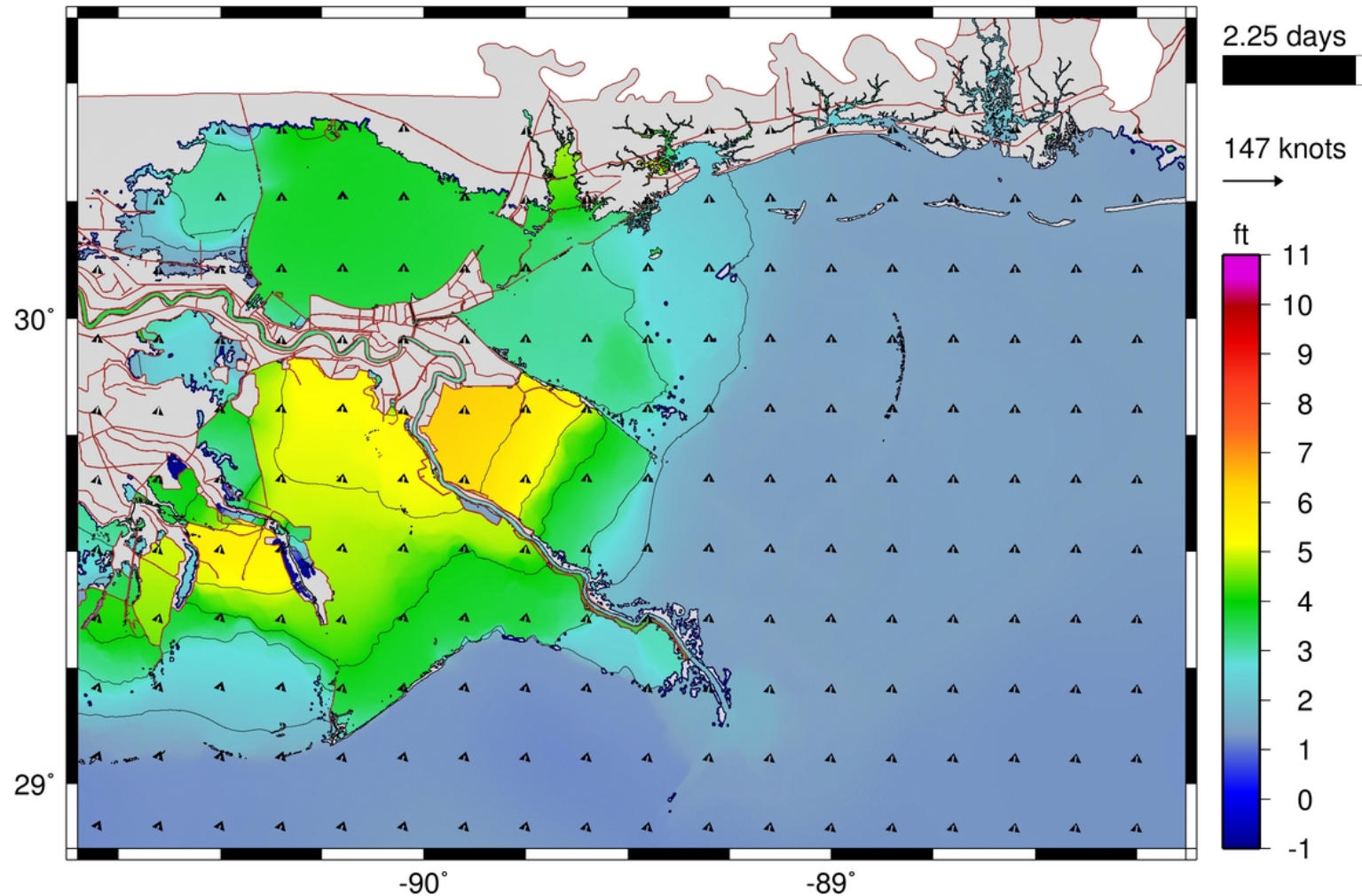
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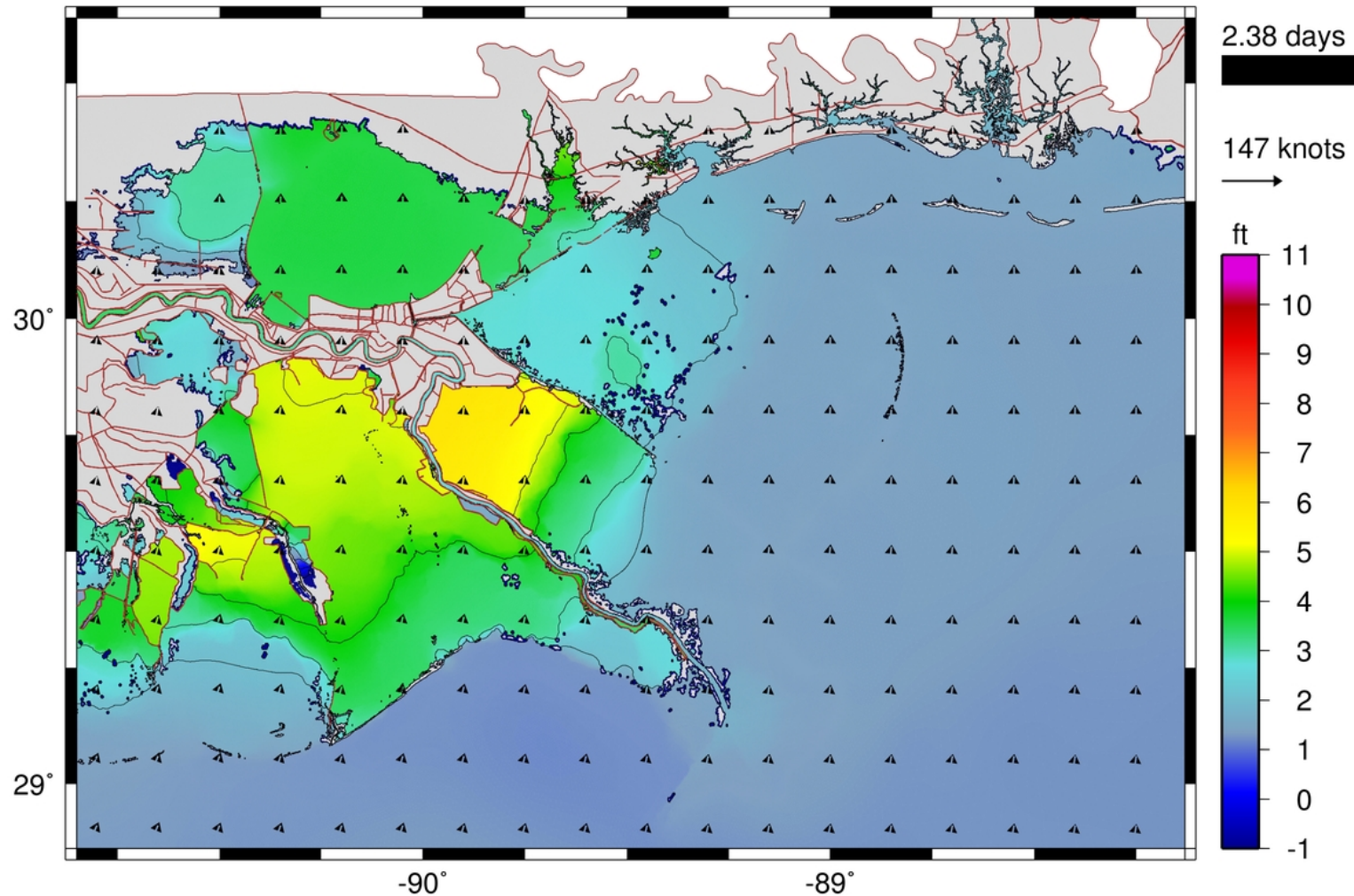
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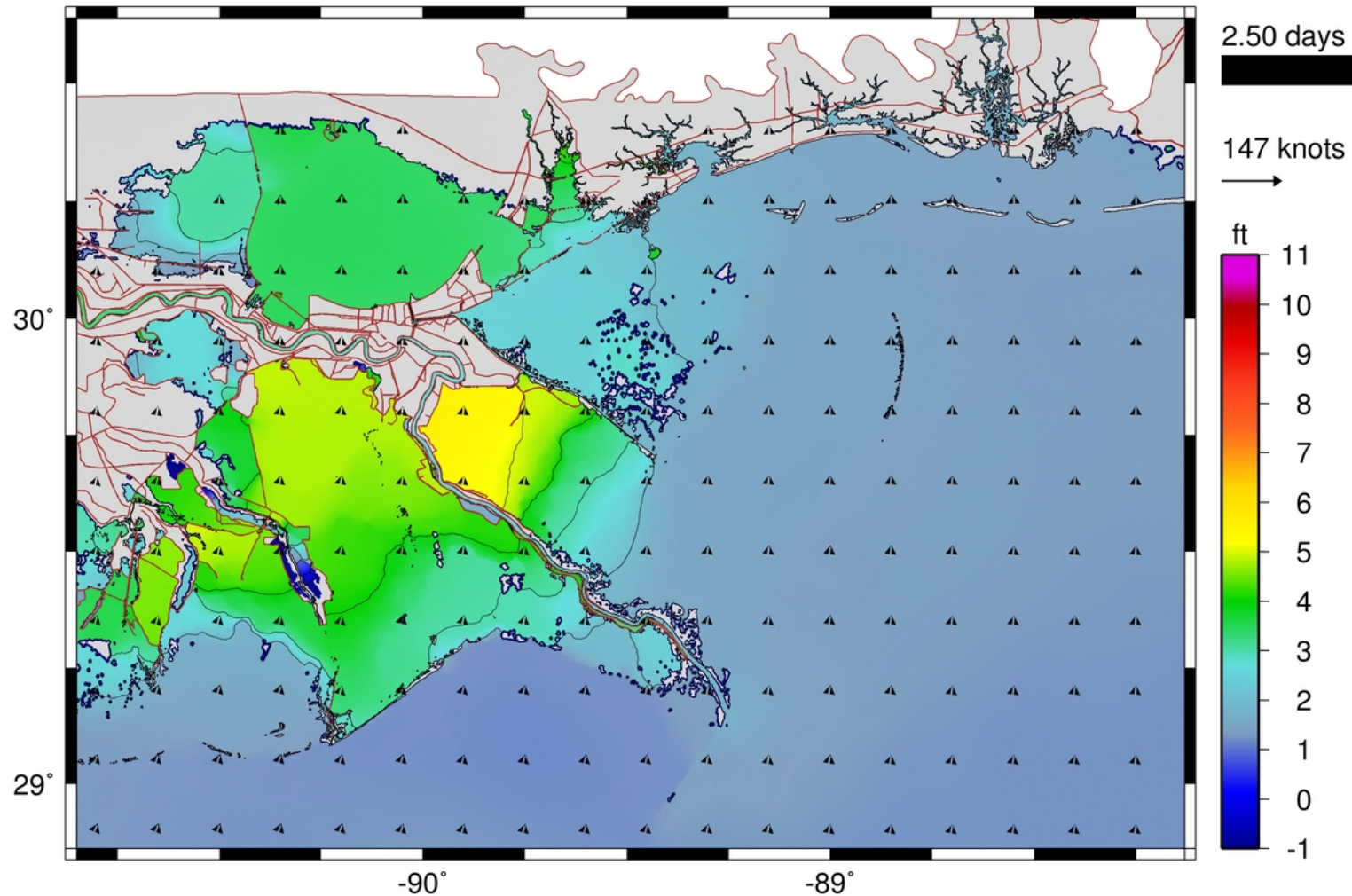
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